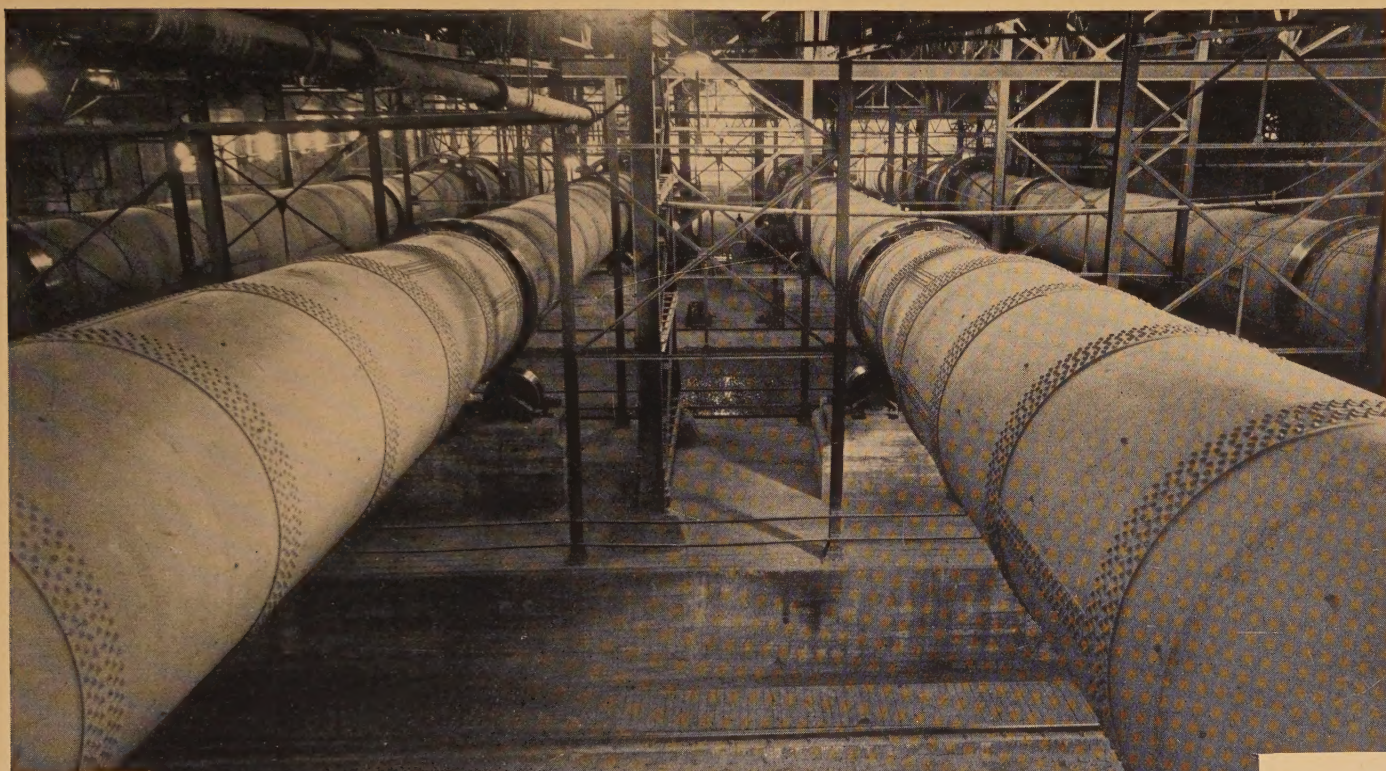


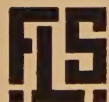
CEMENT MILL SECTION of  
**Concrete**

# SEVEN MILES OF ROTARY KILNS

During the years 1927-30, the Smidth organization sold 139 Rotary Kilns. The total length of these is about **seven miles**, and their annual output more than 60,000,000 barrels. Of these, 125 are Unax Kilns with the cooling cylinders mounted on the outlet end of the kiln shell. Among these are several kilns 400 feet long.



*Four Unax Kilns, furnished by F. L. Smidth & Co.,  
for a cement plant in North America*



Increased fuel economy, improved operation of kiln, effective cooling, better and easier grinding clinker, lower installation cost and other advantages of these modern kilns, account for their enthusiastic reception.

*Write for information*

**F. L. SMIDTH & COMPANY**  
**ENGINEERS**

225 Broadway

*Designers and Equippers of Cement Making Factories*

New York, N. Y.

*This advertiser is showing his readiness to serve you as business improves*

# CEMENT MILL SECTION of Concrete

The Cement Mill Edition of Concrete is edited exclusively for those interested in the manufacture of portland cement. Its pages are devoted to discussions of plant design, management, operation, production efficiency, chemical research and control, quarry operation, progress and news of the industry.

The Cement Mill Edition also contains all the material published in the corresponding Regular Edition and so provides news of the uses and merchandising of the materials whose manufacture is discussed in the Mill Edition. The Regular Section furnishes mill operating officials and mill executives valuable points of contact with the users of the materials they produce.

Volume 40

February, 1932

Number 2

## CONTENTS

|                                                                                                                                            |    |
|--------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>Products of Hydration and Hydrolysis of Portland Cement (Illus.)</b> .....                                                              | 51 |
| <i>The first chapter of a treatise prepared by R. J. Colony and D. L. Snader; preliminary studies made with chemically pure compounds.</i> |    |
| <b>High Quality Cements No Monopoly of Large Production Units</b> .....                                                                    | 56 |
| <i>Discussion by E. Leduc of the production of high quality cements by the small plant.</i>                                                |    |
| <b>Editorial</b> .....                                                                                                                     | 59 |
| <i>Widening That Margin From Below.</i>                                                                                                    |    |
| <i>Masonry Cements Not a Serious Factor.</i>                                                                                               |    |
| <b>Swope Answers Critics of Plan to Stabilize Industry</b> .....                                                                           | 60 |
| <i>Reply by Gerard Swope to criticisms made of stabilization plan.</i>                                                                     |    |
| <b>34 Per Cent of Plants Complete 1931 Without Accident (Illus.)</b> .....                                                                 | 61 |
| <i>Safe operation shown on increase in 1931; plants that earned trophies.</i>                                                              |    |
| <b>Electric Haulage and Crushing Plant at Trinity's Fort Worth Quarry (Illus.)</b> .....                                                   | 63 |
| <i>Description of operation as prepared by J. W. Ganer and Bureau of Mines includes detailed costs.</i>                                    |    |
| <b>Head of Cement Association Sees Home Owning Popularized</b> .....                                                                       | 65 |
| <i>Edward J. Mehren optimistic on future home building.</i>                                                                                |    |
| <b>Longer Shipping Route and New Terminal on Marquette Program (Illus.)</b> .....                                                          | 66 |
| <i>Latest developments in the expansion program of the Marquette Cement Manufacturing Company in Illinois.</i>                             |    |
| <b>Men and Mills</b> .....                                                                                                                 | 67 |
| <i>News of activities of various kinds.</i>                                                                                                |    |
| <b>Mill Equipment (Illus.)</b> .....                                                                                                       | 68 |
| <b>About the Manufacturers of Equipment</b> .....                                                                                          | 70 |

Copyright, 1932, by Concrete Publishing Co.

## INDEX TO ADVERTISEMENTS

|                              |    |                               |            |                         |    |
|------------------------------|----|-------------------------------|------------|-------------------------|----|
| Allis-Chalmers Mfg. Co. .... | 69 | Engineering & Designing ..... | 46         | Link Belt Co. ....      | 71 |
| Books .....                  | 72 | General Motors Truck Co. .... | Back Cover | Smidth, F. L., Co. .... | 49 |
|                              |    | Kritzer Co., The .....        | 46         |                         |    |

# Products of Hydration and Hydrolysis of Portland Cement

## *Part I of Investigation of the Constitution of Portland Cement and Properties of Cement Components—Four Compounds Prepared as Basis for Study*

By R. J. COLONY

Associate Professor of Geology, Columbia University, New York, N. Y.

---

A thorough and painstaking study of the constitution of portland cement and the properties of cement components, with their relations to the disintegration of concrete, has been made by R. J. Colony, associate professor of geology, Columbia University, and D. L. Snader, research fellow, Columbia University, and professor of civil engineering, Stevens Institute of Technology.

The results of their study have been published as Bulletin No. 4, Department of Civil Engineering, Columbia University, in two parts, with Prof. Colony as author of Part I and Prof. Snader as author of Part II.

This first installment of Part I deals with the preliminary studies made with chemically pure compounds. The next installment applies the results of the preliminary study to the case of portland cement. Later issues will cover Prof. Snader's study of the physical properties and characteristics of tricalcium silicate, dicalcium silicate, tricalcium aluminate, and dicalcium ferrite.—The Editors.

---

THE deterioration of concrete under service conditions has been studied by D. L. Snader and the writer in the field and in the laboratory. The field inspection covered numerous concrete structures in various stages of deterioration ranging from incipient to advanced and, wherever permission could be obtained from the owners, representative samples of deteriorated concrete were cut out. These samples of concrete were studied and tested in our laboratories; the tests made included the determination of the physical properties of the concrete, a microscopic examination of thin sections, and sometimes a chemical analysis.

The studies made on concretes in various stages of deterioration showed that in general the disintegration of

concrete is confined to the complex hydrated cement matrix, the so-called binder. Disintegration of the binding material was found most pronounced in those structures which are exposed to contact water and here the deterioration is most marked in those places where the evaporation and percolation of water are most pronounced.

Low physical properties of the concrete as affected by mechanical conditions of manufacture such as proportions and quality of coarse and fine aggregates, mixing, placing and curing are very important contributing factors but not essentially primary ones in retarding or preventing the deterioration of concrete masonry. Nevertheless the engineer's object in the making and placing of concrete should be to secure as watertight and impervious a concrete as it is economically possible to produce.

Some of the products of hydrolysis of all commercial portland cements are chemically unstable to the extent that they may undergo complete hydrolysis in the presence of water with the production of gelatinous silica and alumina and calcium hydrate. With the water confined in the interstices of the concrete, hydrolysis ultimately ceases as the water becomes saturated with the soluble products resulting from hydrolysis; on the other hand, with water percolating through the mass, hydrolysis continues slowly until it has been carried to completion or nearly so.

This paper does not deal with the deterioration and disintegration of concrete resulting from mechanical abrasion or wear or the action of frost.

An investigation of the causes of the disintegration of concrete masonry involves primarily a study of the constitution of portland cement and its hydration products. Such a study should include the determination of the physical properties and the chemical stability in water of the products of hydration. All of this has been done by preparing and testing artificially prepared, chemically pure hydrated components of portland cement. Studies both microscopic and by means of X-rays have been made to determine the major hydrated constituent components of portland cement in the samples of concrete removed from existing structures in various stages of disintegration. The physical properties of the concrete in these samples have also been determined.

The results obtained to date of the microscopic, X-ray and other studies made of portland cements, their products of hydration and hydrolysis, and a few of the studies made upon thin sections of concrete, both sound and

---

From Bulletin No. 4, Department of Civil Engineering, Columbia University, New York, July, 1931.

partially disintegrated, are set forth in Part I<sup>1</sup> of this paper.

Part II<sup>2</sup> covers the results of physical tests and measurements made upon what had been assumed in the past were the four principal constituent components of portland cement, namely, tricalcium silicate, dicalcium silicate, tricalcium aluminate and dicalcium ferrite. Recent studies by Bogue and his associates, subsequent to the work set forth in this paper, have convinced them that the iron in portland cement exists in the form of  $4\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{Fe}_2\text{O}_3$  and that dicalcium ferrite does not exist as such in portland cement.

## PART I—THE PRODUCTS OF HYDRATION AND HYDROLYSIS OF PORTLAND CEMENT

THE literature dealing with cementitious materials and with the constitution of portland cement is voluminous. In *Paper No. 3* of the Portland Cement Association Fellowship at the Bureau of Standards, Washington, R. H. Bogue presents "A Digest of the Literature on the Constitution of Portland Cement Clinker," citing 71 titles, embracing the more important contributions up to and including the year 1925. In this paper Bogue gives an excellent summary of the methods, results and interpretations of the work of investigators whose researches occupied this particular field within the period of time mentioned.

During the three years succeeding 1925, many additional papers bearing on the same problem were published by the Portland Cement Association Fellowship.

Notwithstanding the very extensive researches that have

<sup>1</sup>By R. J. Colony.

<sup>2</sup>By D. L. Snader.

been conducted in the past by many investigators in North America, in Europe and in Japan, no generally accepted solution of the problem of the constitution of portland cement clinker has yet been reached. During the co-operative study of defective concrete taken from many different structures in various parts of the United States, which has been in progress in the past two years, we found it advisable to restudy the behavior of the assumed individual components of portland cement, although much work has previously been done in that direction.

The re-study of the four principal components commonly believed to constitute portland cement was undertaken in order that we might personally observe the behavior of each individual component and study the products of hydration when it was subjected to the tests usually applied to commercial portland cement.

### PREPARATION OF THE COMPOUNDS

The components were prepared from chemically pure analyzed reagents; precipitated alumina, precipitated calcium carbonate, precipitated silica and ferric oxide were used. The mixes were prepared to yield as final products dicalcium silicate,  $2\text{CaO} \cdot \text{SiO}_2$ ; tricalcium silicate,  $3\text{CaO} \cdot \text{SiO}_2$ ; tricalcium aluminate,  $3\text{CaO} \cdot \text{Al}_2\text{O}_3$ , and dicalcium ferrite,  $2\text{CaO} \cdot \text{Fe}_2\text{O}_3$ . Boric oxide (0.5 per cent) was added to the lime-silica mixes in order to facilitate their burning.

All of these mixes were heated in 800-gram lots in a gas-fired furnace whose temperature was controlled by readings at 10 minute intervals, using a Leeds and Northrup optical pyrometer. In all cases the different mixes were burned, ground and reburned until satisfactory results were obtained, which were determined by checking the products of the various heats by optical methods.

The finished product of each heat was then subjected to chemical analysis, an X-ray diffraction pattern was made

| Product                                   | No. of Heats | Temp. of Burning °C  | Indices of Refraction | Chemical Composition                                            |                                 |
|-------------------------------------------|--------------|----------------------|-----------------------|-----------------------------------------------------------------|---------------------------------|
|                                           |              |                      |                       | Analysis                                                        | Theoretical                     |
| $2\text{CaO} \cdot \text{SiO}_2$          | 3            | Range<br>1446°–1450° | $\alpha$ 1.716        | % CaO = 65.36                                                   | CaO = 65.12                     |
|                                           |              |                      | $\gamma$ 1.732        | % $\text{SiO}_2$ = 33.60                                        | $\text{SiO}_2$ = 34.88          |
|                                           |              |                      | $\pm .003$            | % $\text{Fe}_2\text{O}_3$<br>and $\text{Al}_2\text{O}_3$ = 0.80 |                                 |
| $3\text{CaO} \cdot \text{SiO}_2$          | 5            | Range<br>1446°–1458° | 1.716                 | % CaO = 73.92                                                   | CaO = 73.68                     |
|                                           |              |                      | $\pm .003$            | % $\text{SiO}_2$ = 26.28                                        | $\text{SiO}_2$ = 26.32          |
|                                           |              |                      |                       | % $\text{Fe}_2\text{O}_3$ = trace                               |                                 |
| $3\text{CaO} \cdot \text{Al}_2\text{O}_3$ | 6            | Range<br>1377°–1384° | 1.710                 | % CaO = 62.40                                                   | CaO = 62.22                     |
|                                           |              |                      | $\pm .003$            | % $\text{Al}_2\text{O}_3$ = 37.88                               | $\text{Al}_2\text{O}_3$ = 37.78 |
|                                           |              |                      |                       | % $\text{SiO}_2$ = trace                                        |                                 |
|                                           |              |                      |                       | % $\text{Fe}_2\text{O}_3$ = none                                |                                 |
| $2\text{CaO} \cdot \text{Fe}_2\text{O}_3$ | 2            | Range<br>1379°–1382° | *2.261                | % CaO = 40.32                                                   | CaO = 41.17                     |
|                                           |              |                      | 2.274                 | % $\text{Fe}_2\text{O}_3$ = 59.60                               | $\text{Fe}_2\text{O}_3$ = 58.83 |
|                                           |              |                      | $\pm .01$             | % $\text{SiO}_2$ = trace                                        |                                 |

\*Through the courtesy of Mr. J. W. Grieg, Geophysical Laboratory, Washington, D. C. Mr. Grieg also checked the indices of the other products; his determinations agree with those of Colony.

and the indices of refraction were re-determined. A general summary of the results is given in the accompanying table.

These materials were finely ground in a ball mill and stored in large desiccators to prevent hydration from atmospheric moisture. They correspond in their physical properties to the same substances made and described by previous investigators.

Numerous cylindrical test pieces were made from these components. The results of the physical studies and tests on the cylinders are described and discussed in Part II of this bulletin.

## HYDRATION AND HYDRATION PRODUCTS

Thin sections were made of some of the test cylinders stored both in the damp closet and under water in order to determine approximately the extent of hydration and the nature of the hydration products.

### 1. Dicalcium Silicate $2\text{CaO} \cdot \text{SiO}_2$

When this compound is gauged with water and made up into test pieces calcium hydroxide is liberated, and amorphous hydrated calcium silicate is formed whose composition approaches  $\text{CaO} \cdot \text{SiO}_2 \cdot \text{Aq}$ . The amount of crystalline calcium hydrate formed is dependent on the amount of water used, and on other factors involving equilibrium. Test pieces are usually made with such a limited amount of water that saturation with calcium hydroxide rapidly ensues, and hydrolysis proceeds very slowly. The gelatinous amorphous hydrated calcium silicate coats the grains of dicalcium silicate, acting as a protective envelope, and this also tends to retard hydrolysis, so that much of the dicalcium is unaffected. It may never hydrolyze completely, even through a very long lapse of time. Test pieces stored under water were more completely hydrolyzed than those stored in the damp

closet, but even under such circumstances much unhydrolyzed dicalcium silicate still existed in the test pieces after a lapse of four months.

The cementing process depends on the formation of gelatinous hydrated calcium silicate mixed with minute plates and needles of crystalline calcium hydroxide, which renders the mass coherent and firm. (See Figure 1.)

### 2. Tricalcium Silicate $3\text{CaO} \cdot \text{SiO}_2$

This compound hydrolyzes much more readily than dicalcium silicate, yielding more calcium hydroxide in the process, which crystallizes mixed with amorphous hydrated silicate of calcium, and with non-hydrolyzed remnants of tricalcium silicate. Some of the calcium hydroxide in solution may precipitate as calcium carbonate by reaction

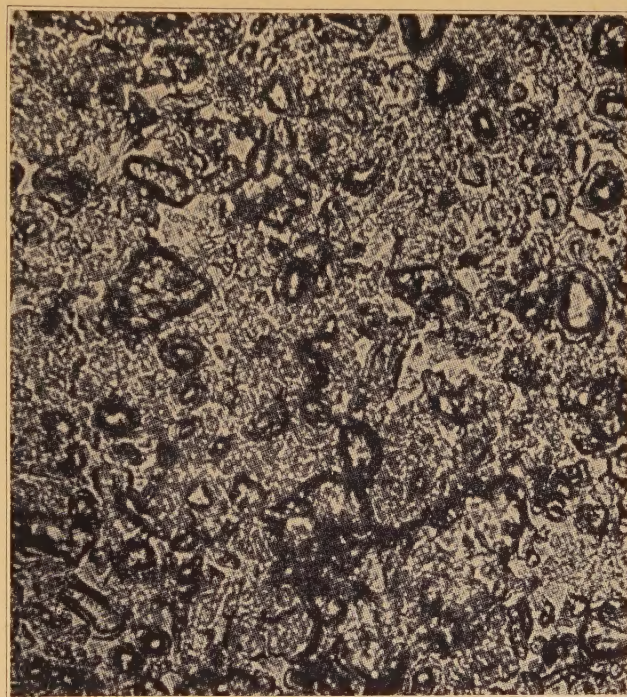


Figure 2. Tricalcium silicate in test cylinder, magnified 400 times. Cured in damp closet 40 days and stored under water two months

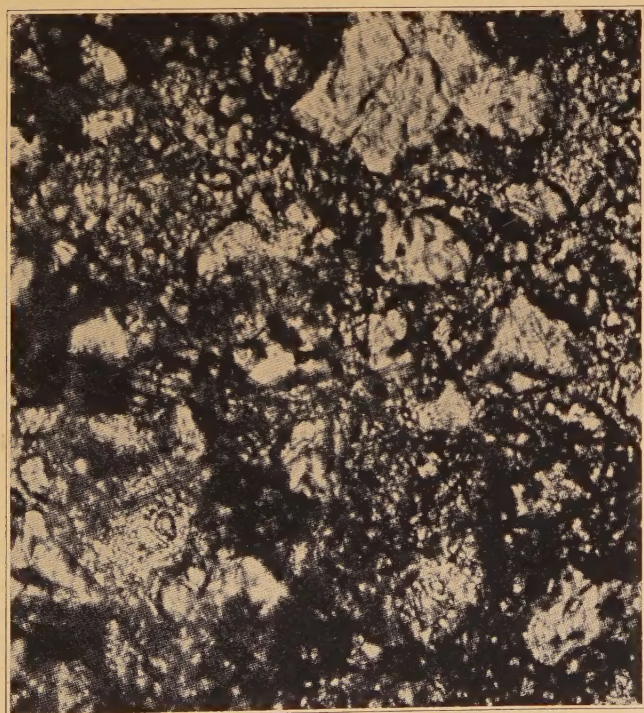


Figure 1. Dicalcium silicate in test cylinder, magnified 400 times. Cured in the damp closet 40 days, and stored under water for two months

with carbon dioxide in the air. Storage of test pieces under water increased the extent of hydrolysis, but many grains in the test pieces thus stored were enveloped in a coating of gelatinous hydrated calcium silicate which retarded the hydrolysis of the grains so enveloped. Both dicalcium silicate and tricalcium silicate yield the same products when hydrolyzed, but tricalcium silicate furnishes more crystalline calcium hydroxide than does dicalcium silicate, and the test cylinders made of tricalcium silicate gave higher returns in compression tests than cylinders made of dicalcium silicate. Since the hydration products of both these silicates are the same, but the proportion of crystalline calcium hydrate in the tricalcium silicate cylinders is greater, one is forced to conclude that there must be a direct relation between the strengths of the test pieces, the proportion existing between the two products of hydrolysis, crystalline calcium hydroxide and hydrated calcium silicate, and the extent of hydrolysis. Scalenohedral crystals of calcite covered the surfaces of test cylinders of both dicalcium silicate and tricalcium

silicate which were stored under water for several months. These crystals were larger and much more abundant on the test cylinders of tricalcium silicate, however, forming in aggregate masses and in radiate acicular groups. Test cylinders of both dicalcium silicate and tricalcium silicate stored under water for several months were slightly carbonated, effervescing when treated with dilute hydrochloric acid. The carbonate in the cylinders was distributed in finely granular form mixed with the "leucocol."

### 3. Tricalcium Aluminate $3\text{CaO} \cdot \text{Al}_2\text{O}_3$

According to the results obtained by Klein and Phillips,<sup>1</sup> by Bates and Klein,<sup>2</sup> by Bates,<sup>3</sup> Rankin<sup>4</sup> and others,<sup>5</sup> tricalcium aluminate hydrates forming amorphous hydrated tricalcium aluminate, with or without amorphous alumina, the aluminate (hydrated) later crystallizing (as crystalline hydrated tricalcium aluminate).<sup>6</sup> All of the men who have made and worked with this compound have observed the considerable evolution of heat when it is mixed with water, and the difficulty of making satisfactory test pieces because of this strongly exothermic hydration reaction, which engenders "flash-set," with resulting incomplete hydration has been commented on. Bates<sup>7</sup> states that the rapid rise in temperature occurring when the finely ground "clinker" of tricalcium aluminate is mixed with water, is due to partial hydration confined largely to the exterior of the individual grains, and that provided kneading of the mass is continued after it has cooled somewhat, a very plastic mass is produced. Bates found that Vicat test pieces so made, and placed under water at the end of 24 hours, disintegrated in the course of a few hours. Provided these test pieces were allowed to "harden" for several days before immersion in water they did not disintegrate so rapidly, but in the course of several months they checked on the surface and increased very much in volume. This accords with our own experience. Test cylinders made of this material, aged in the damp closet for periods varying from 14 days to 192 days, split and cracked badly in 24 hours after immersion in water and suffered complete disintegration in a short time thereafter. The cylinders retained some semblance of their form only because their exteriors were thoroughly carbonated, the carbonated outside shells serving as a supporting frame work for the otherwise thoroughly disintegrated mass. Moreover, calcium hydroxide was formed which was converted into calcium carbonate by reaction with the carbon dioxide in the air; the outside surfaces of the test pieces and the walls of the containing vessel as well were covered with calcite crystals, and the outer parts of the cylinders

were carbonated, whereas the inner parts were soft, mushy and gelatinous.

Microscopic study of these disintegrated cylinders disclosed needles of crystalline hydrated tricalcium aluminate radiating from gelatinous grains, and spherulites of the same crystalline compound, with a very few minute crystalline plates of the same substance, and an amorphous gel.

Moreover, the cylinders stored in the damp closet were carbonated, although test cylinders of the two calcium silicates stored with the tricalcium aluminate cylinders and exposed to the same conditions were very slightly affected by atmospheric carbon dioxide. (See Figure 3.)

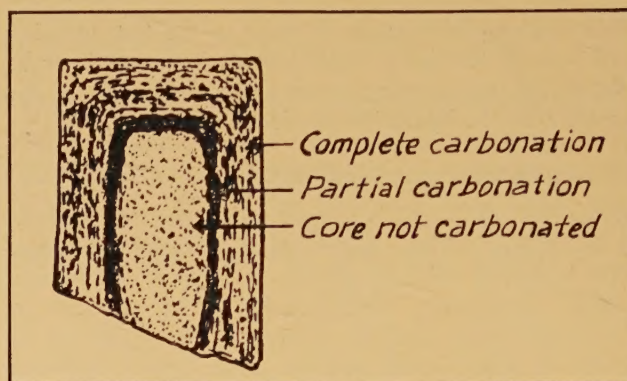


Figure 3. Drawing of section through portion of test cylinder of tricalcium aluminate, magnified 2 times

According to our own experience with tricalcium aluminate, we find that it is possible to make test pieces which will exhibit considerable compressive strength after storage in the damp closet for reasonable periods of time; but when these test pieces are immersed in water, disintegration begins in less than 24 hours, proceeding very rapidly, with accompanying carbonation provided air is not excluded from contact with the water in which the test pieces are immersed; not only does simple hydration occur, but there takes place more or less hydrolysis with the formation of calcium hydroxide which is converted to calcite, and either a less basic hydrated aluminate or actual hydrated alumina itself.

### 4. Dicalcium Ferrite, $2\text{CaO} \cdot \text{Fe}_2\text{O}_3$

Test cylinders of this compound cracked and checked very badly in the damp closet. Calcium hydroxide and an indefinite hydrated lime-iron compound resulted by hydrolysis when the material was mixed with sufficient water to make the test pieces. Considerable dicalcium ferrite remained unacted on in the form of grains weakly cemented together with mixed amorphous colloidal hydrated lime-iron compound and crystalline calcium hydrate. The amount of crystalline calcium hydrate formed in the test cylinders was small, however.

According to the recent experiments of Lerch and Bogue,<sup>8</sup>  $3\text{CaO} \cdot \text{SiO}_2$ ,  $\beta 2\text{CaO} \cdot \text{SiO}_2$ ,  $\gamma 2\text{CaO} \cdot \text{SiO}_2$ ,  $5\text{CaO} \cdot 3\text{Al}_2\text{O}_3$ ,  $3\text{CaO} \cdot \text{Al}_2\text{O}_3$  and  $2\text{CaO} \cdot \text{Fe}_2\text{O}_3$  all hydrolyze in aqueous solution. Provided sufficient water is used and

<sup>1</sup>Klein, A. A., and Phillips, A. J., Hydration of Portland Cement. Technologic Paper 43, Bureau of Standards, 1914.

<sup>2</sup>Bates, P. H., and Klein, A. A., Properties of the Calcium Silicates and Calcium Aluminate Occurring in Normal Portland Cement. Technologic Paper 78, Bureau of Standards, 1917.

<sup>3</sup>Bates, P. H., Cementing Qualities of the Calcium Aluminates. Technologic Paper 197, Bureau of Standards, 1921.

<sup>4</sup>Rankin, G. A., Transactions of the Faraday Society, 1919.

<sup>5</sup>Bogue, R. H., A Digest of the Literature on the Nature of the Setting and Hardening Processes in Portland Cement. Paper 17, Portland Cement Association Fellowship, Bureau of Standards.

<sup>6</sup>See especially Klein and Phillips, op. cit., Bates and Klein, op. cit., Bates, op. cit., and Rankin, op. cit.

See also Wells, Lansing S., Reaction of Water on Calcium Aluminates, Research Paper No. 34, Bureau of Standards, 1928.

<sup>7</sup>Bates, P. H., Cementing Qualities of the Calcium Aluminates. Technologic Paper 197, Bureau of Standards, 1921.

<sup>8</sup>Lerch, William and Bogue, R. H., Studies on the Hydrolysis of Compounds which may occur in Portland Cement. Paper No. 11, Portland Cement Association Fellowship, National Bureau of Standards, 1927. Reprinted from Journal of Physical Chemistry, 31, 11, 1927, pp. 1627-1646.

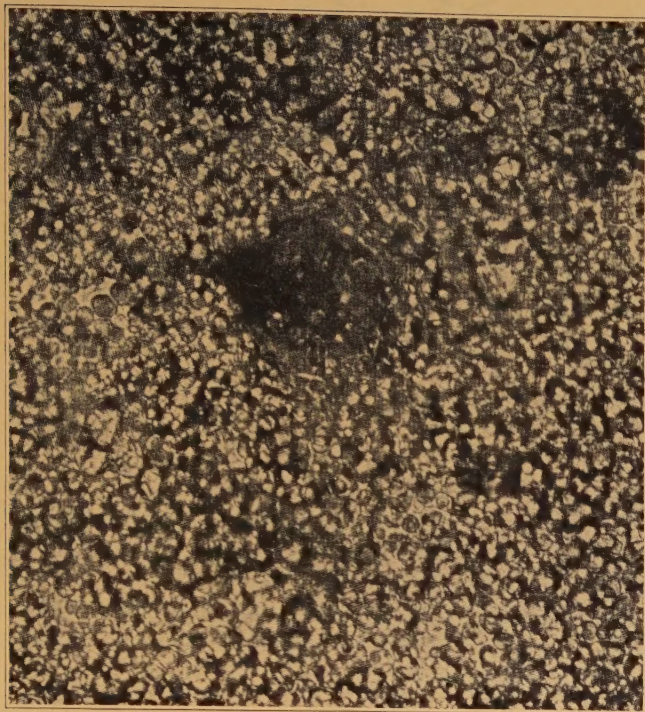


Figure 4. Tricalcium aluminate from interior core of test cylinder, magnified 400 times

the soluble products are removed from time to time the silicates will hydrolyze to hydrous silica, the aluminates to hydrous alumina and the ferrite to hydrous ferric oxide. In each case calcium hydroxide is the other product. Provided the soluble products are *not* removed, however, but still in the presence of large amounts of water (200 c.c. water and from 0.300 to 0.500 gram of each compound) hydrolysis proceeds to the formation of a less basic silicate (than the one hydrolyzed) and to the formation of a less basic aluminate or ferrite. The test cylinders used in our own experiments were made with

the very minimum amount of water possible, which was rapidly saturated with calcium hydroxide. This product was "removed" to a certain extent through precipitation in the crystalline form, allowing slow but progressive hydrolysis to proceed to a somewhat limited degree. The results that occasioned the most surprise were the uniformly rapid and complete disintegration of the tricalcium aluminate cylinders after immersion in water, and the cracking and checking of the dicalcium ferrite cylinders in the damp closet.

### Satisfactory Sales and Shipments Reported by Northwestern

A satisfactory year in sales and shipments and a larger number of orders on the books than a year ago was the report made by officers at the annual meeting of the Northwestern States Portland Cement Co. held at Mason City, Iowa, on December 15.

There was every expectancy, according to President MacNider, that the plant would continue operating through the winter months on a schedule as heavy as orders on the books and capacity would allow.

Col. MacNider was re-elected president and general manager of the firm, while Frank J. Hanlon, formerly a director, was elected vice-president, taking the place of A. F. Frudden of Hollywood. Willis G. C. Bagley was re-elected treasurer.

William Stern, cashier of the Dakota National Bank of Fargo, former national vice-commander and North Dakota department commander of the American Legion, was elected to the board, the former members of which were re-elected.

Fred A. Ontjes, one of the stockholders of the company, presented the claims under which he is bringing suit seeking to enjoin the company from reorganizing from a West Virginia to an Iowa concern. Other stockholders refused to join him in the action, indicating he was alone in his position.

### Lehigh Indiana Plant Reopens to Capacity Run

Operations were resumed at the Mitchell, Ind., plant of the Lehigh Portland Cement Co. on January 4, to continue at full capacity until summer and perhaps beyond.

A total of 275 men went back to work, bringing the total number employed there to 290.

The firm was recently awarded a contract for 33,000 bbl. for state highway use.

### Two Alpha Plants Get 1,300,000-Bbl. Order From Illinois

Word that the company had been awarded a contract for 1,300,000 bbls. of cement by the Illinois state highway department reached the Alpha Portland Cement Co. plant at La Salle, Ill., on January 21. Its share will be 700,000 bbls., the remaining 600,000 bbls. being allotted to the Cape Girardeau plant.

About 200 men who had been idle since November 1 were expected to be put back to work.

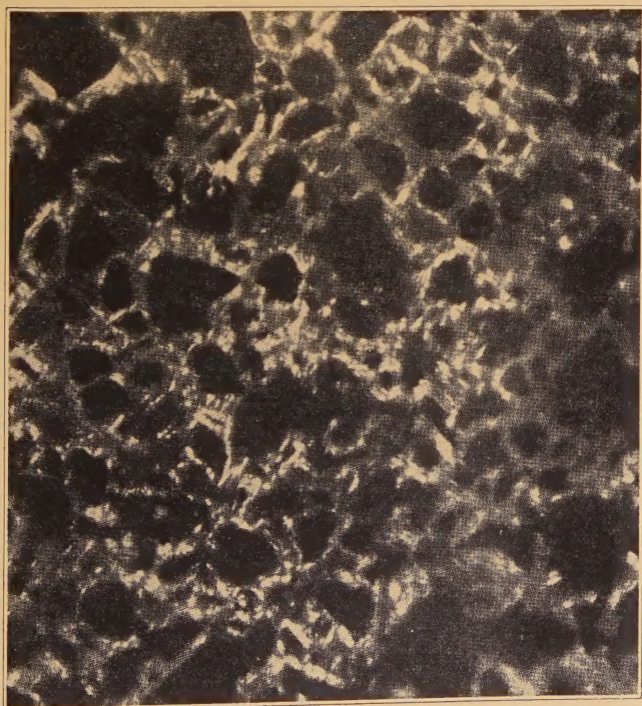


Figure 5. Dicalcium ferrite from test cylinder stored in damp closet, magnified slightly less than 400 times

# High-Quality Cements No Monopoly of Large Production Units

Smaller Plants Have Higher Production Cost But Lower Overhead—Lack of Proper Technical Staff a Serious Handicap—Raw Materials Discussed in Detail

By E. LEDUC

Honorary Chief of Section of Materials of Construction of the National Conservatory of Arts and Trades, Paris

WE have no intention of attempting to determine whether, from the social standpoint, all things being equal, several plants each producing a certain tonnage of cement are preferable to a single large plant manufacturing the same tonnage as the combined production of the smaller units. Nevertheless, it is certain that a plant of medium size, well located, well arranged and well managed, will yield a higher proportional profit than a large plant. There is evidently a certain equilibrium to be found as to the proper size, varying with each particular case, and also varying with different industries.

## "Economizing" on Technical Staff May Be Fatal

One of the principal causes from which the small plant suffers, and which in the majority of cases runs the treasury into debt, is the total absence of technical direction.

If under these conditions the product of the smaller plant is unable to bear comparison with that of the large plant, and if, as a result, the smaller concern fails, the causes of the failure are not due to the low production capacity, but to the weakness of the technical staff and lack of judgment on the part of the administrative management.

On the other hand, if the management of the plant of medium size possesses a full understanding of the indispensable necessities, and has sufficient capital at its disposal, this plant will produce a positive return on the investment.

## Advantage of Low Overhead Costs

Granting that the small concerns and the plants of medium size generally have a net cost of production higher than that of the large plants, the latter, on the contrary, have their general administrative and financial expenses at so high a level that these expenses absorb and often exceed the economies due to their greater production.

## Very Small Plant Produces High Quality

We have shown, in a study published in 1929 in the *Revista de Obras Publicas*, that we had manufactured portland cement of the highest quality in a diminutive factory, inasmuch as its production was only from about 105 to 120 bbl. per 24 hrs. However, the cement produced was utilized in the construction of permanent

works of a most exacting character in reinforced concrete.

This plant had been installed for the particular needs incident to the construction of a dam in the Spanish Pyrenees, which explains its small production capacity.

We pointed out in the description of this little factory that the quality of cement produced is independent of the tonnage manufactured.

## High Quality No Monopoly of Large Plants

Since then (and that is the object of this study) we were able to show, by the example of the cement plant at Xeuilley, that it is possible to manufacture cement of high quality in a mill of medium size. It is therefore erroneous to think that high-quality cements are a monopoly of the very large companies.

The two examples prove that the consumers have equal security in the output of cement from a large plant or from a plant of medium size or smaller, if the latter is properly organized.

## Great Importance of Raw Materials

It is well known that for the manufacture of portland cement, it is necessary to prepare the raw materials containing silica, alumina and iron oxide, generally found in the form of clay, and lime, generally in the form of carbonates. One encounters some natural products containing lime in the form of silicates, but they are rare and seldom recommended.

At the small plant in Spain, previously mentioned, we utilized limestone and clay. The analyses given in Table 1, made during a period of several years, show the homogeneity of these primary materials.

TABLE 1

*Composition of Raw Materials for Small Plant in Spain*

|                     | Limestone |         | Clay    |         |
|---------------------|-----------|---------|---------|---------|
|                     | Maximum   | Minimum | Maximum | Minimum |
| Silica .....        | 1.10      | 0.20    | 69.75   | 67.00   |
| Alumina .....       | 1.00      | .23     | 18.40   | 15.70   |
| Iron oxide.....     | .64       | .20     | 6.00    | 5.00    |
| Lime .....          | 55.00     | 54.20   | 1.90    | 1.20    |
| Magnesia .....      | .50       | .30     | .40     | .15     |
| Sulphuric anhydride | .60       | .14     | .60     | .20     |

## The Double Burning Process

Instead of carbonate of lime, one can, by applying an old formula of Vicat, employ lime, from which process

Translated from *Le Ciment* (Paris), November, 1931.

the expression "double burning" is derived, since the carbonate of lime has been burned previously during its transformation into lime.

This procedure, which, at first thought, appears complicated, has been given few applications. Two plants in the Department of Ardeche utilize this process, and the same is true of several plants in the vicinity of Tournay, in Belgium. It is the procedure employed at the plant at Xeuilley.

### Sources of Principal Raw Materials

It is evident that cement can be made from pure and compact limestone to supply the lime, from iron ore to supply the iron oxide, from white sand to supply the silica, and from white bauxite to supply the alumina; or the iron oxide and the alumina may be obtained from red bauxite. Nevertheless, the use of such raw materials untreated is not recommended. As is well known, to obtain a complete combination of these products it is necessary to reduce them to an extreme fineness, in order that the silica, the alumina, the lime and the iron oxide may become completely diffused and combined at a high temperature.

After pulverization, weighing and mixing, the raw meal at the Xeuilley plant was briquetted and the briquettes were burned in vertical shaft kilns. The burning was particularly difficult.

### Why High Degree of Fineness Is Necessary

The use of such materials requires a high degree of fineness, because the difficulties of combination increase as the sizes of the grains increase. The microscope shows that a grain produced mechanically by a tube mill, even though it passes a sieve having 4.900 meshes per sq. cm. (178 meshes per lin. in.), is still a grain of enormous size when compared with the size of grains of certain finely ground marly limestones or of certain siliceous limestones.

We are not familiar with any tests made to determine the relative influence of the fineness of the four ingredients—silica, alumina, iron oxide and lime—on the temperature required for their combination.

In our papers published in 1911 (on the constitution of portland cement), we attached a report on the employment of products previously reduced to great fineness, but without determining the influence of that fineness.

### Rule About Composition of Raw Materials

In the case just cited—where slag, quicklime, sand, iron ore and limestone flux were used as raw materials—it was necessary to burn at a high temperature and to prolong the action of this temperature in order to obtain combination of these materials. Under these conditions the burning operation required excessive fuel, the output of the kilns was small and their refractory linings lasted only a short time.

In consequence, the more nearly the natural raw materials approach the desired composition—that is, the composition of the pulverized raw mixture or the briquettes—the easier will be the burning and the higher will be the quality of the cement.

### Plant Employs Five Raw Materials

We have been occupied for some time with a portland cement manufacturing plant which employed five raw materials, namely, slag, limestone flux, iron ore, sand and quicklime. The composition of each of these materials is shown in Table 2.

It is a rather rare thing to encounter a preparation of raw materials so nearly perfect. However, certain plants, such as the one at Porte de France, obtain raw materials from quarries in which the homogeneity is such that some analyses made 50 years ago are exactly like those being made today. This limestone is so perfect and so fine in texture that one can not distinguish one grain from among those surrounding it, even when they are examined under strong magnification.

### Remarkable Uniformity in Composition

The limestone quarried by the Societe de Xeuilley likewise shows a most remarkable uniformity in its chemical composition, over a long period of time. The analyses given in Table 3 show the results of tests on samples taken from limestone beds separated by marly deposits.

The limestone quarried at the present time has, therefore, exactly the same composition as that quarried 60 years ago.

The lime produced from this limestone has the high degree of uniformity that would be expected from the analyses in Table 3.

It is also because the marly limestone in the region of Boulogne-sur-Mer combines its qualities of fineness and uniformity that the development of the cement industry

TABLE 2  
*Analyses of Five Raw Materials Used by One Plant*

|                                 | Limestone |        | Iron ore | Sand   | Quicklime | Raw mixture before burning |
|---------------------------------|-----------|--------|----------|--------|-----------|----------------------------|
|                                 | Slag      | flux   |          |        |           |                            |
| Silica                          | 31.60     | 0.66   | 7.73     | 96.84  | 2.13      | 14.24                      |
| Alumina                         | 19.55     | .71    | 5.84     | traces | none      | 5.07                       |
| Peroxide of iron                | 1.03      | .17    | 49.97    | 1.94   | -----     | 2.63                       |
| Lime                            | 43.22     | 55.15  | 14.30    | traces | 95.65     | 46.10                      |
| Magnesia                        | 2.32      | traces | 1.22     | -----  | .62       | .81                        |
| Sulphur and sulphuric anhydride | 1.18      | none   | none     | none   | none      | 1.35                       |
| Peroxide of manganese           | .27       | -----  | .37      | -----  | -----     | .11                        |
| Phosphoric acid                 | traces    | -----  | 1.64     | -----  | -----     | -----                      |
| Loss on ignition                | none      | 43.49  | 19.00    | 1.55   | .80       | 30.00                      |
| Hydraulic coefficient           | -----     | -----  | -----    | -----  | -----     | 2.09                       |
| Silica coefficient              | -----     | -----  | -----    | -----  | -----     | 1.85                       |

TABLE 3

*Uniformity in Chemical Composition Over Long Period*

|                                                                     | Clay,<br>per cent | Lime,<br>per cent |
|---------------------------------------------------------------------|-------------------|-------------------|
| Average of 29 superimposed beds,<br>analyzed in 1929.....           | 14.90             | 47.40             |
| Average of 41 superimposed beds,<br>analyzed in 1884.....           | 14.98             | 45.50             |
| Average of the upper 24 superimposed<br>beds, analyzed in 1873..... | 14.89             | 45.96             |
| Average of 18 other superimposed<br>beds, analyzed in 1873.....     | 15.02             | 44.50             |

in that section was relatively easy. The marly deposits of that region present, in fact, some remarkable qualities favoring their transformation into cement.

#### Utilizing More Difficult Raw Materials

As the use of cement became more and more extensive, it was necessary to build cement mills in regions other than Boulogne-sur-Mer. The industry succeeded, however, in manufacturing good cement, even though utilizing raw materials of very different kinds and difficult to prepare. At the beginning of that industry, the use of such raw materials would often have led to a check in its progress.

#### Advantage of Constant Chemical Composition

If the physical and chemical homogeneity of raw materials is interesting, it is however, less important in the manufacture of portland cement than in the making of natural cement. Nevertheless, it is much easier to manufacture a finely pulverized product of constant chemical composition if one starts out with raw materials of equally constant composition, than if the manufacturer must manipulate raw materials in which not only the proportions of the different elements vary, but in which the ratios between these elements are variable.

#### Variations in Resistance to Grinding

If the raw materials differ greatly as to chemical composition and as to resistance to grinding, these materials must be ground very finely, because the less finely divided particles—coming from the hardest materials—introduce a notable difference of composition among the fine particles.

It is thus that we have found, in the raw mixture coming from the cement plant previously cited, which uses five different raw materials, 33.40 per cent of insoluble residue in the portion retained on the sieve having 4,900 meshes per sq. cm. (178 meshes per lin. in.), as against 19.90 per cent of insoluble residue in that which had passed the meshes of this sieve.

These considerations are of even more importance if the burning takes place in an upright kiln instead of being done in a rotary kiln.

#### Correcting the Raw Mixture

It is evident that one can always arrive at a suitable composition of the raw mixture through correction by the addition of silica in the form of sand, iron oxide in the form of iron ore or ashes of pyrites, and alumina in the form of bauxite.

Instead of adding pure silica sand it is preferable to add a sand that is slightly clayey. Combination will thereby be facilitated. Whatever the kind of sand added, it is indispensable to have it very finely pulverized.

In some tests conducted by us almost 20 years ago we have shown that by adding (to a normal raw mixture) 5 per cent of sand passing a sieve having 144 meshes per sq. cm. (30 meshes per lin. in.) and retained on a sieve having 324 meshes per sq. cm. (45 meshes per lin. in.) there was produced, after burning, no less than 30 per cent of inert and uncombined dust. When the same proportion of sand, but ground to such fineness that it passed the 4,900-mesh sieve (178 meshes per lin. in.), was added, then pulverized anew, it had not brought about any production of inert dust. For that test the pellets made from the mixture were burned in a gas-fired kiln.

A very interesting little experiment can be made by introducing a grain of sand having a diameter of about 2 m/m into a small pellet of the raw mixture. After burning, it is observed, on breaking the clinkered pellet, that a diminutive geode coated with dust exists in place of the grain of sand.

(To be continued)

### British Cement Firm Increases Profits

The Central Portland Cement Co., Ltd., of England, reports profits totalling £28,616 in comparison with £28,593 in the preceding year.

In postponing the payment of an interim dividend in the middle of the year the directors announced that this was merely a measure of precaution, and they were not dissatisfied with the trading results at that date. Their view was justified, and as the result of the year's operation the previous year's dividend of 7½ per cent is being repeated. A balance of £22,229 is carried forward, against £21,889 brought in.

### Buffington Production to Be Doubled; Improvements Near Finish

Increase of production on February 1 to 66⅔ per cent of capacity was anticipated at the Buffington, Ind., plant of the Universal Atlas Cement Co., doubling the previous rate of production.

At that time also it was expected that the \$1,750,000 improvement program would be completed.

### 1931 Statistics in March Issue

Compiling of figures for the year 1931 and the removal of the Department of Commerce to its new building at Washington has caused a delay in the release of the cement statistics issued monthly by the Bureau of Mines and published in these pages.

Their publication will, however, be resumed with the March issue of CONCRETE, when the closing totals of 1931 will be indicated.

# EDITORIAL

## *Widening That Margin from Below*

NOW that the price of cement has bounced along at a low level for several years, it may not be an easy matter to work the price up to the former levels, even if a substantial increase in demand should develop.

The larger purchasers, such as state highway departments, know how to obtain new bids unless the price is within a figure which they consider reasonable. Large private purchasers, knowing what the highway departments are paying, will do shopping on their own account if the prices quoted them are too far above the quotations to highway departments. In a word, the state highway departments have become a powerful factor in holding the price of cement at a low figure.

Granting that this estimate of the situation is correct, the present narrow margin between cost and selling price can not be widened a sufficient amount by increasing the price of cement. Part of the widening must be accomplished through further reductions in production costs.

Many a cement plant management that is now suffering loss might be enjoying a fairly satisfactory condition with its present volume of business if its plants were equipped with economical machinery. During the long period of prosperity these managements did not feel the need of installing economical equipment. At the prices and the demand then prevailing they were able to get a certain share of the business and to make a profit. Now they are paying for their former complacency.

Other company managements were sufficiently farsighted to make changes that led to production economy, at times when prosperity was upon them. In many cases those same companies are continuing that practice.

Consider, for example, what was accomplished in that direction even in 1931. Several Canadian cement plants changed from the dry to the wet process as a step toward economy in addition to installing other economy-producing equipment. Another Canadian plant installed a new kiln not for additional capacity, but to economize through the reduced fuel consumption. The same plant also installed new grinding machinery. An eastern plant installed one long, modern type of kiln to replace four old and shorter kilns, also to economize in fuel. One of the large cement groups installed long, modern kilns in several of its plants, to cut down on fuel consumption; and this group, likewise, replaced much of its old grinding machinery with modern types in 1931. Other plants obtained fuel economy by installing chain systems in existing kilns. Several midwestern plants reduced grinding

costs by means of air separator installations, and one company owning two plants is now replacing its old clinker coolers with a modern and much improved type, from which the heat will be recovered and utilized.

There is the further necessity for dealing with high-early-strength cements and the higher specifications for normal cement. To produce these better cements, changes must be made in plants. Many plants have made those changes, but many others have not even begun to do so.

A few plant managements are still antagonistic toward high-early-strength cements, which are destined, as their use increases, to speed up construction work, to lower the cost of concrete construction, to reduce the extra cost of winter construction, to lengthen the normal construction season, and, in consequence, to lengthen the production and shipping seasons for cement plants.

Cement executives who are depending on price increases to restore profits may look in vain for increases of substantial proportions. The safer course, if the margin between cost and selling price is to be widened, is to widen it from below—by taking advantage of every possible means of reducing production costs.

## *Masonry Cements Not a Serious Factor*

SO-CALLED "masonry" cements, including natural and puzzolan cements as well as several forms of hydraulic lime, are much less of a factor as a competitor of portland cement than is generally supposed.

While figures for 1931 are not as yet available, mill shipments in this entire group averaged only slightly more than 2,000,000 barrels annually during the 6-year period from 1925 to 1930, inclusive. Like portland cement, this little industry reached a peak in 1928 and has been declining since then.

Eleven plants located in nine states produce this annual output of approximately 2,000,000 barrels. Nearly all of it is used in mortar for masonry work.

In several sections of the country the sales departments of one type of masonry cement have promoted the use of their product in concrete work on the basis of a 50-50 mixture with portland cement. Such action has, quite naturally, drawn fire from the portland cement industry.

So long as the sales departments of the masonry cement industry remain within their logical field of masonry mortars, the portland cement industry has little to gain in disputing that field with them. The prize is too small to justify the expenditure of much promotional effort in this direction.

# *Swope Answers Critics of Plan to Stabilize Industry*

**Emphasizes Voluntary Character of Action—Refuses to Accept Theory That Industry Can Not Be Stabilized—Experience Will Suggest Modifications**

---

Before the Academy of Political Science at the Hotel Astor, in New York, on November 13, Gerard Swope, president of the General Electric Company, made answer to some of the criticisms of his plan for the mitigation of industrial conditions such as we have experienced. Mr. Swope originally presented his plan in an address before the National Electrical Manufacturers' Association on September 16. He emphasized the "voluntary action" element in his plan, as opposed to compulsion, and reaffirmed his belief that stabilization of industry, particularly of employment, is possible by the procedure he has suggested, with full protection of the public interest.

The following excerpts are taken from Mr. Swope's talk at the Hotel Astor.—The Editors.

---

**W**HETHER the plan suggested in my address on September 16 is meritorious or not, the experience gained in endeavoring to put it into practice would of itself tend to correct its weaknesses. To believe, as some do, that industry simply cannot be stabilized, is to adopt what Senator La Follette has termed the "counsel of despair," which would be a negation of all effort toward progress.

No doubt the plan for stabilization of industry along the lines that I have suggested would have to be modified as we have more experience, but such experience can be gained only by trying one scheme or another to solve the problem, which, unsolved, leaves us with all the present chaotic, unhappy and finally unendurable consequences.

## **Supreme Court's Attitude**

Concerning the dissemination by trade associations of knowledge regarding trade practices and ethics, and the standardization of products, an opinion of the Supreme Court, handed down in 1925, held that "the natural effect of the acquisition of wider and more scientific knowledge of business" could hardly be deemed a restraint of commerce, or at least not an unreasonable restraint, "or in any respect unlawful."

I believe American industry has long since passed the

point where trade associations would curtail production, causing increases in prices to the public, a fear expressed by some people. What the industry would endeavor to do would be to prevent over-production, and would regard as an unfair competitor any member of such trade association who, knowing the consuming power of the public and the stocks on hand in the possession of all members of the association, nevertheless built up a large inventory, which later must be sold at reduced prices, quite regardless of cost. Such practices are unfair to the competitors themselves, and highly unfair to the labor employed; and such prices below cost for a brief period are of no lasting benefit to the consuming public.

## **Changes in Sherman Law**

Modification of the Sherman anti-trust law along the line recommended by the American Bar Association to remove the criminal aspects of the law and to allow companies to make agreements which would be filed with the Federal Trade Commission and the Department of Justice is one method that would encourage companies to participate in the plan by joining their respective trade associations. Another method which would aid in this direction would be to allow participating companies to deduct from their federal taxes the sums which they contribute to employe welfare funds.

## **Will Not Put Government in Business**

To those critics who have expressed the belief that my plan would mean in reality putting the government in business, let me answer by pointing out that throughout the plan I have advocated that the initiative be taken by the trade associations and not by the government. The government supervisory body would act as a referee or umpire to interpret unfair competition between members, or if necessary to protect the welfare of the public by its interpretation of agreements filed with the Federal Trade Commission, or by its study of production and price trends.

## **Protecting the Public Interest**

The public interest will be protected, it seems to me, because the federal supervisory body will receive reports periodically showing the volume of shipments and the amount of merchandise on hand. They will also know the price at which the merchandise has been sold at retail and they will have filed with them the income statements of members of the trade association, prepared on a uniform basis.

The volume of shipments will show whether production has been curtailed; the amount of merchandise on hand

will show whether production is outrunning consumption or vice versa; the retail price of the article will show the price trend; and the analysis of income statements, made on a uniform basis, will show whether the profits of the corporations engaging in this business have increased or decreased. These factors, it seems to me, would give all the information necessary for a federal supervisory body to protect the public interest.

If, as already suggested, Congress, by modifying and clarifying the Sherman law, encourages companies to join trade associations and offers inducement for such companies to stabilize employment, and these measures are approved and supported by public opinion, almost every company will join in this constructive endeavor and no compulsion will be necessary.

#### Employment Stabilization Most Important Feature

I consider the stabilization of employment, meaning as-

surance of employment with unemployment insurance if necessary, to be the most important feature of the plan.

The result of taxing industry for a portion of the cost will be to put a premium on industry's finding ways of stabilizing employment. The collateral effects, therefore, of unemployment insurance will be much more important to the employe, to industry, and to society than unemployment insurance itself.

#### Is Part of Manufacturing Cost

An important factor, which I think is basic, is that the cost of the product will include these items and will therefore be paid for by the users of the articles and not in general by members of the community through taxation.

Even if industry itself falls short of an ideal accomplishment, more progress will be made and it will be better done and cost less than if the government, either state or federal, endeavors to do it.

## 34 Per Cent of Plants Complete 1931 Without Accident

Mark Establishes New Record Among Portland Cement  
Association Members—Two Have Five-Year Perfect  
Records—Reduced Operation Eliminates Five

**T**HIRTY-SIX cement mills throughout the United States and Canada won the Portland Cement Association safety trophy for 1931, operating throughout the year without a single lost-time or more serious accident. Five additional plants which were in substantial operation but which burned clinker less than six months, completed the year with a clean safety record but were ineligible to receive the award.

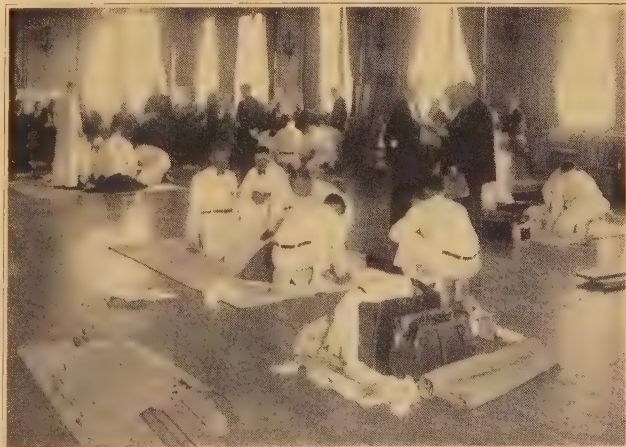
#### Record Is Unequaled

Considering the greatly reduced number of mills operated in the industry throughout 1931, the results of last year's contest were better than ever before. Thirty-four per cent of the operating mills had no accidents serious enough to cause loss of even a day's time to any workman. During the previous year forty-six mills were correspondingly free from accident and forty-three qualified for the association's award; but there were approximately twenty more mills then in operation within the membership of the association, so that the percentage of winners to operators was slightly lower.

#### Early Expectations Exceeded

When the Portland Cement Association started its annual trophy contest in 1923 the thought was to award one trophy a year. Consequently an expensive cast stone monument was designed and held up as a worth-while

award to the plant which could complete a year with the lowest number of accidents. According to the expectation of those who planned the contest at the beginning, nine years should have seen the award of just nine trophies. The possibility of perfect safety records was not foreseen,



Scene as first aid teams demonstrated their ability during regional safety meeting at Albany, New York, in 1931

although in 1924, the year after the contest was started, the first perfect safety record was made.

During the nine years since the contest was started there

have been 137 awards and re-awards to a total of 87 different plants. In fact, the trophies have found their way into every cement producing region in the United States and Canada and there are only forty plants in the present membership of the association which have not received the trophy and are eligible.

### Table of Records

The accompanying table of winners gives an idea of the accomplishments of the mills which won in 1931. The Iola, Kansas, mill of the Lehigh Portland Cement Co., again heads the list with an accident-free record of over five years. It is closely followed by the Ironton, Ohio, mill of the Alpha Portland Cement Co., which has also passed the five-year mark. The San Antonio, Texas, mill of the San Antonio Portland Cement Co., which was the first winner of the trophy, won again in 1931 for the fourth time.

### Formal Awarding

Each mill which wins the award for the first time receives the monument provided by the Portland Cement Association and is entitled to send delegates to the spring meeting of the association at New York to receive the formal award. Mills which have won previously are entitled to have their monuments reinscribed at the expense of the association and to send delegates to the meeting of the association. Monuments are to be manufactured at once and will be shipped to the various winning mills during May and June, according to the Accident Prevention Bureau of the association.

At the spring meeting of the Portland Cement Association in New York in May, records of these mills will be formally canvassed and the formal awards made to the delegates who assemble there from the various mill organizations. After the erection of the trophies on the mill grounds the formal unveiling and dedication ceremonies will be held throughout the summer and fall months.

Some of the winning mills are already at work planning their celebrations.

## Safety Trophies Awarded for 1931

| Company          | Plant                 | Superintendent      | Days                  |
|------------------|-----------------------|---------------------|-----------------------|
|                  |                       |                     | Clear to Jan. 1, 1932 |
| *Lehigh          | Iola, Kansas          | C. A. Swiggett      | 1,939                 |
| *Alpha           | Ironton, Ohio         | F. C. Brownstead    | 1,849                 |
| *Medusa          | Toledo, Ohio          | W. J. Worthy        | 1,365                 |
| *Lehigh          | Ormrod, Pa., No. 2    | Wm. J. Montz        | 1,254                 |
| *Lehigh          | Birmingham, Ala.      | R. H. MacFetridge   | 1,223                 |
| *Pacific         | Redwood City, Cal.    | A. G. Lang          | 1,129                 |
| *Great Lakes     | Buffalo, N. Y.        | A. T. BeVier        | 1,107                 |
| *Nazareth        | Nazareth, Pa.         | H. A. Reichenbach   | 989                   |
| *North American  | Howes Cave, N. Y.     | J. W. Campbell      | 824                   |
| *Manitowoc       | Manitowoc, Wis.       | F. E. Town          | 820                   |
| *Canada          | Exshaw, Alta.         | W. D. Armstrong     | 756                   |
| *San Antonio     | San Antonio, Tex.     | H. O. Rinehold      | 751                   |
| *Trinity         | Fort Worth, Tex.      | A. A. Chaney        | 749                   |
| *Cuban           | Cayo Mason, Cuba      | John Rae            | 742                   |
| *Lone Star Ala.  | Spocari, Ala.         | W. W. Deadman       | 719                   |
| Superior         | Concrete, Wash.       | H. A. Ambler        | 707                   |
| *Hercules        | Nazareth, Pa.         | J. Stanley Downs    | 689                   |
| *Lone Star Ala.  | Birmingham, Ala.      | W. M. Cabaniss      | 669                   |
| Santa Cruz       | Davenport, Cal.       | Fred Davis          | 626                   |
| Canada           | Lakefield, Ont.       | E. W. Bailey        | 586                   |
| Yosemite         | Merced, Cal.          | A. P. DeJonckheers  | 567                   |
| Calaveras        | San Andreas, Cal.     | R. H. Townsend      | 549                   |
| Pitts. Pl. Glass | Fultonham, Ohio       | Robt. W. McAllister | 542                   |
| *Lehigh          | Ormrod, Pa., No. 3    | Wm. J. Montz        | 534                   |
| Ash Grove        | Louisville, Nebr.     | A. K. Frolich       | 502                   |
| Lehigh           | Oglesby, Ill.         | John Young          | 467                   |
| Southwestern     | Osborn, Ohio          | W. T. Groner        | 455                   |
| Glens Falls      | Glens Falls, N. Y.    | F. P. Monaghan      | 406                   |
| Southwestern     | El Paso, Tex.         | H. E. Nichols       | 402                   |
| Lawrence         | Thomaston, Maine      | A. L. Wolf          | 395                   |
| Olympic          | Bellingham, Wash.     | A. F. Krabbe        | 387                   |
| Penn-Dixie       | Valley Junction, Ia.  | R. A. Bechtold      | 380                   |
| Univ. Atlas      | Leeds, Ala.           | B. E. Merrell       | 379                   |
| Univ. Atlas      | Northampton, Pa.      | M. W. Winsch        | 379                   |
| Lehigh           | Metaline Falls, Wash. | H. Helwig           | 369                   |
| Univ. Atlas      | Independence, Kans.   | C. M. Carman        | 366                   |

### Plants With Perfect Records But Ineligible Because of Not Having Burned Clinker for an Aggregate of 6 Months

|          |                   |                |     |
|----------|-------------------|----------------|-----|
| *Canada  | Ft. Whyte, Man.   | V. C. Hamilton | 763 |
| *Newaygo | Newaygo, Mich.    | L. E. Smith    | 750 |
| *Medusa  | York, Pa. (White) | R. J. Landis   | 840 |
| *Medusa  | Bay Bridge, O.    | A. J. Little   | 790 |
| *Cowell  | Cowell, Calif.    | E. D. Barnett  | 769 |

\*Previous trophy winner.



Safety trophies ready to leave shop for shipment to cement plants

# Electric Haulage and Crushing Plant at Trinity's Fort Worth Quarry

Detailed Costs of Drilling, Blasting, Loading, Transportation, Crushing and Grinding Given in New Paper Issued by Bureau of Mines

A TECHNICAL description of the method of quarrying limestone and the detailed costs of the various operating steps at the Fort Worth cement plant of the Trinity Portland Cement Company are given in Information Circular No. 6513, recently issued by the United States Bureau of Mines, Department of Commerce. The author of the circular is J. W. Ganser, chief chemist of the Trinity Portland Cement Co.

The paper gives a brief history of the early quarry operation. This is followed by details of geology and physical characteristics of the deposits. Emphasis is placed on those features which have influenced the method of mining used.

A detailed description of the methods of drilling and blasting includes discussion of the spacing and depth of drill holes, costs per foot of hole, methods of charging and blasting holes, secondary shooting and fragmentation obtained.

## Remote Control Haulage System

The method of loading quarry haulage equipment by steam and electric shovel is described, as well as a detailed description of the haulage system. The Fort Worth quarry uses an electric haulage system operated from a central control station, as described in the April (1931) issue of the *Cement Mill Edition* of CONCRETE, pages 97 and 98. This transportation from the quarry to the plant is by the Woodford (electric) haulage system. This system is controlled by an operator in a control tower which, in this instance, is in the plant above where the

cars are dumped into the receiving hopper, the location being in the control room shown in Figure 1.

The cars, of 10 cubic yards capacity, were built by the Western Wheeled Scraper Co. They are of composite wood and steel construction and are of the one-way, side-dump

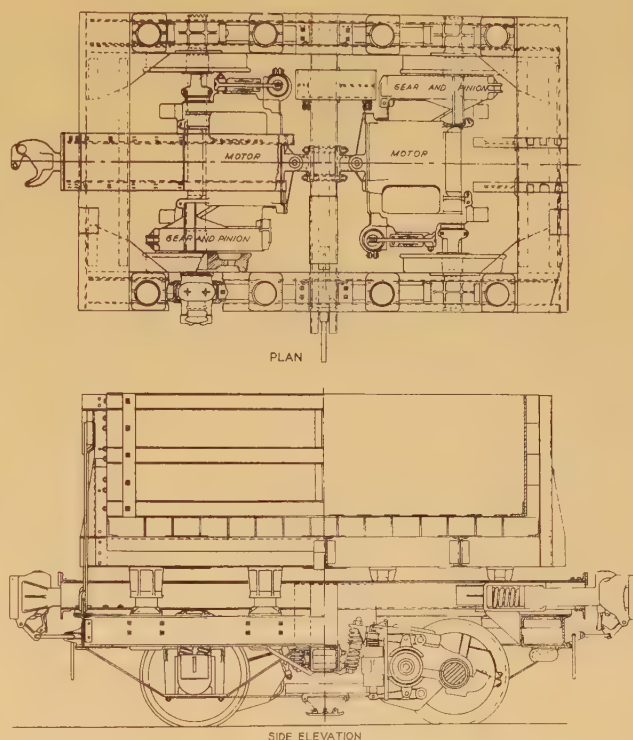


Figure 2. Design of electric quarry cars. Each car has two 30-h.p. motors

type. Each car has two 30-h.p. Allis-Chalmers motors. Each motor drives an axle through direct single-reduction gearing. Three cars are being operated and each is equivalent in power to a 35-ton locomotive, as they will easily switch a box car of gypsum to the place of unloading. Figure 2 shows the design of the cars.

The Woodford system employs a third rail using 250-volt direct current. In some installations this third rail is between the haulage rails, but at this property it is placed on the outside of the rails. It was found that the third rail, when between the two haulage rails, interfered when switching box cars.

Operation of the system is simple, as everything is in full view of the tower operator from the time the cars leave the crusher building until they are loaded and returned to it. Each controller provides for three running speeds, one off position for coasting, and three brake posi-

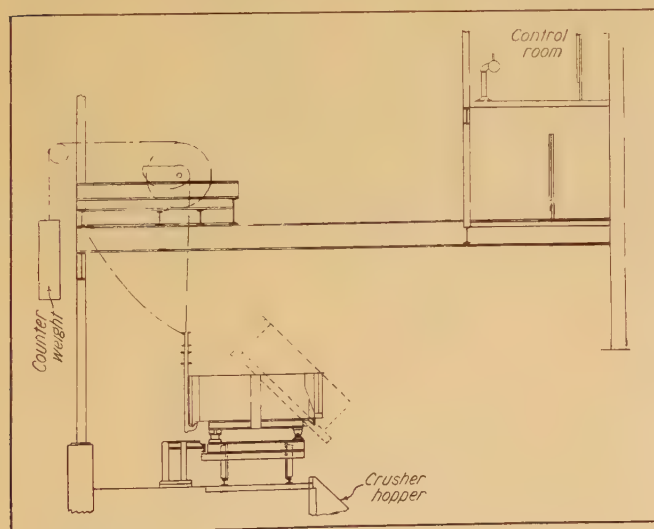


Figure 1. Car-dumping device and location of control room

tions for various brake pressures. With the controller handle in the off position a car will coast until the brake current is turned on. The controls are set so that the operator need not attend to the cars except for a few feet at the loading and discharge ends where they require accurate spotting. The three-speed control gives the cars a range of speed from 12 to 16 miles per hour.

### The Track Layout

The track system is composed of one track going from the crusher house to a switch, and two branches from the switch joining to form a long loop. One side of this loop is parallel to the face and is kept near it to serve as a

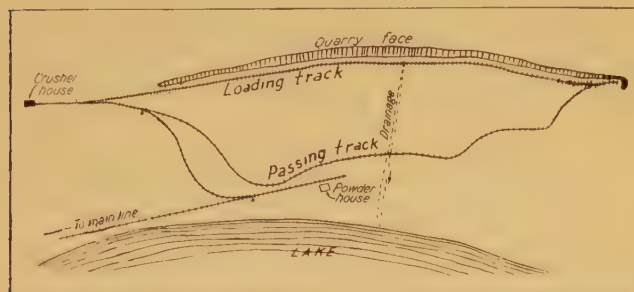


Figure 3. Track layout and line of quarry face

loading track. The other is away from the face and is called the passing track. The usual method is to send empty cars out over the passing track and around the loop, spotting a car at the shovel as soon as the car before it has been loaded and sent to the crusher. The track layout is shown in Figure 3.

### Car Dumping Device

The device which dumps the cars at the crusher (see Figure 1) is also operated by the haulage man. It consists of two hooks which are attached to a frame and yoke. Two chains from this yoke go to cam-quadrants on which the chains wind as the quadrants revolve. The weight of the yoke and hooks is balanced by counterweights fastened to wire ropes which are wound on sheaves on the same shaft as the quadrant. When this shaft is turned by a motor (through gearing) the hooks are lifted, dumping the car sideways, not only quickly but smoothly, and the car body is set back on the bolsters with a minimum amount of jar.

### Crushing by Hammer Mill

The cars are dumped into an 18 by 20 ft. steel-lined hopper from which the rock is discharged by a pan-type feeder, driven by a 5-hp., 440-volt motor, to a No. 7 Williams hammer mill (see Figure 4), driven by a 250-hp., 2,200-volt, 750-r.p.m. motor. The feed to the hammer mill consists of pieces ranging from a 3-ft. cube to  $\frac{1}{8}$  in. in size.

The discharge from the Williams mill is elevated by a 42-in. pan elevator, driven by a 25-hp., 2,200-volt, 720-r.p.m. motor, and discharged onto a short belt 30 in. wide driven by a 5-hp., 440-volt, 720-r.p.m. motor, which carries the rock over a wall into the rock storage.

Following is a screen analysis of the discharge from the Williams mill:

| Size of mesh passed | Per cent |
|---------------------|----------|
| 1½-inch             | 89.5     |
| 1 -inch             | 84.5     |
| ¾-inch              | 75.7     |
| ½-inch              | 67.7     |
| ¼-inch              | 59.0     |
| ⅛-inch              | 30.2     |
| 20-mesh             | 16.7     |
| 30-mesh             | 9.5      |
| 50-mesh             | 5.6      |
| 100-mesh            | 2.7      |

### Rock Storage

The rock after arriving in storage is either put into the section for low-lime or high-lime rock, or taken to the bins feeding the tube mills. The rock storage is 75 ft. wide and 178 ft. long and has a capacity of 10,000 tons. This rock is moved in storage by a Shepard 6-ton traveling crane equipped with a 3-yd. clamshell bucket. This crane has a span of 75 ft. and is equipped with a 10-hp., 1,200-r.p.m., 440-volt trolley motor, two 40-hp., 900-r.p.m., 440-volt hoist motors, and a 40-hp., 900-r.p.m., 440-volt, bridge motor. All of these motors have variable speeds.

As already stated, the quarry is arranged so that high-lime and low-lime rock mixtures may be made. These mixtures can be further varied by adding different proportions of the rock from the crane bin, all of which leads to uniformity and less correction after the raw material has been ground into slurry.

### Three-Compartment Tube Mills

The two tube mills for grinding the raw mixture are adjacent to the rock storage and are fed from a hopper

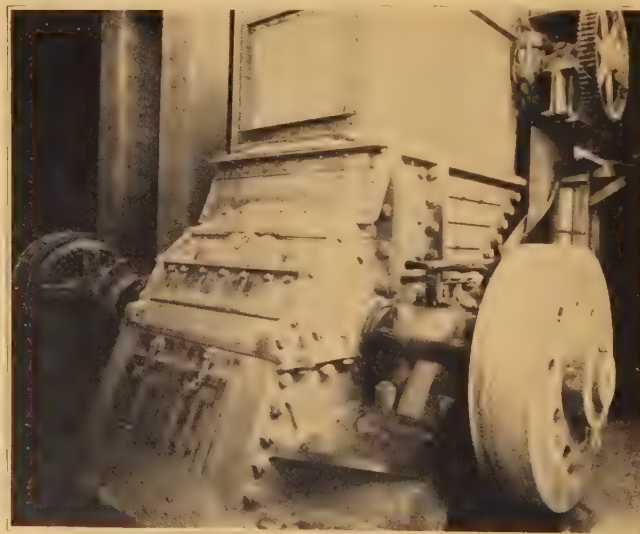


Figure 4. Hammer mill reduces quarry product to size required for tube mills

loaded by the crane. They are 8 by 30-ft. Traylor combination mills, each driven by a 700-hp., 2,200-volt, 180-r.p.m. motor. These mills each have three compartments, so that the reduction is in three stages. The total weight of the grinding media per mill is 70 tons, of which 20 tons of 2 by 4-in. balls are in the first compartment, 20 tons of 1½ in. balls are in the second compartment, and 30 tons of 1 by 1¼-in. slugs are in the third compartment.

The balls consumed per ton of material ground amount to 0.304 lb. Tube-mill liners last from two to three years. The raw slurry from the mills contains 40 per cent of moisture, and 90 per cent of it will pass a 200-mesh screen. The two mills grind at the rate of 29.39 tons per hour, or 14.70 tons per mill per hour.

The slurry from the mills flows to a bucket-elevator pit from which it is elevated to silos, where it is agitated before being fed to the kilns and burned at 2,700 deg. F.

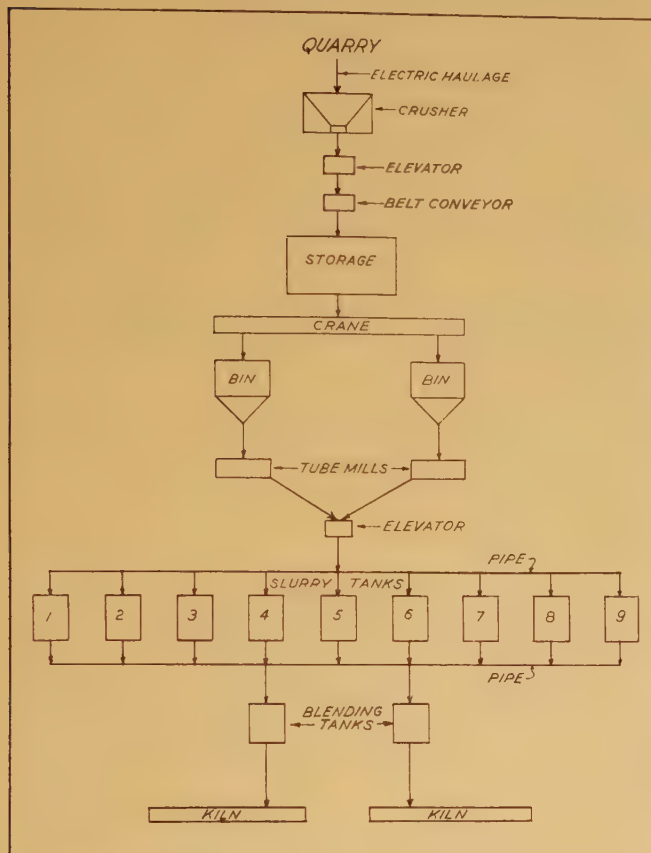


Figure 5. Flow sheet from the quarry to the kilns

into portland cement clinker. Figure 5 shows the flow sheet from the quarry to the kilns.

Mr. Ganser is the author of another paper describing the Dallas quarry operations of the Trinity Portland Cement Co., which has been issued by the Bureau of Mines as Information Circular No. 6498 and was reprinted in full in the November (1931), December (1931) and January (1932) issues of the *Cement Mill Edition of CONCRETE*.

Both of these Information Circulars (Nos. 6498 and 6513) contain detailed cost data over a period of one year. Tabulations cover the costs of drilling, blasting, loading, transportation, crushing, elevating, grinding, conveying, drying, miscellaneous plant and overhead in dollars per ton of stone produced. These are followed by tables showing the labor expenditure in man-hours per ton and the power in kwh. per ton.

These two papers are of particular interest as affording direct cost comparisons between two operations under one management, but with entirely different operating conditions.

Copies of either or both circulars may be obtained from the United States Bureau of Mines, Washington, D. C.

## Head of Cement Association Sees Home Owning Popularized

Mehren Points to Financial Hurdles and Automobile Promotion—Fireproof Homes as Investment Security

An optimistic note regarding the future for home building was touched recently by Edward J. Mehren, president of the Portland Cement Association, at the recent annual meeting in Chicago. Mr. Mehren is well known in the building field as an able merchandiser.

### A New Era in Home Building

In commenting on the tremendous financial obstacles in the pathway of thousands of prospective home owners, Mr. Mehren felt that, serious as these difficulties are, none are beyond the possibility of removal by concerted action. When unnecessary hindrances in connection with financing have been removed, he visioned the building of hundreds of thousands of dwellings throughout America, even making comparison with the unparalleled development of the automobile industry. As indicative of progress in the removal of these hindrances he cited the proposal of the president for the establishment of a mortgage rediscount bank, now before Congress.

Mr. Mehren said in part:

"We may soon be going into an entirely new era with reference to home building.

"The great trouble with the building of dwellings today lies in the difficulties of financing. A man can go out and get a better rate on financing an automobile which will wear out in four or five years and be thrown away than he can get to put a house over his head—to make himself a part of the community and to be able to hold up his pride in citizenship because he has a stake in that community and an adequate home for himself and his family.

"That situation reflects upon the American people. Lately there has been a considerable sentiment raised against it. It is being commented upon in the newspapers almost daily."

### Fireproof Homes for Investment Security

As an important element in securing more liberal terms for the borrower and providing better security to the investor, Mr. Mehren suggests the advantage of building homes fireproof or substantially so. This proposal should not come as extraordinary at this time, in view of the almost universal adoption of fireproof construction for hotels, schools and apartments and the availability of a wide variety of suitable materials, satisfying architectural demand and personal preference.

In voicing his belief in the possibilities of interesting prospective purchasers far beyond the limits of past experience, thereby bringing a new measure of prosperity to the building field, Mr. Mehren continued:

"I am one of those who believe that you can make a fireproof home as much a source of pride in this country as you can the ownership of an automobile. I do not know of anything that can be presented to the public more successfully than that—appealing to the home owning interests of the average man. Such a movement, carefully guided, must meet with success."



The M.S. Wm. Dickinson, bulk cement barge of the Marquette Cement Manufacturing Company, which plies the Illinois River

## Longer Shipping Route and New Terminal on Marquette Program

1932 to See Erection of a Permanent Barge Terminal on Illinois River Near La Salle—Shipping Route to Be Extended 350 Miles—\$25,000 Improvements Planned at Peru Terminal

THE engineering staff of the Marquette Cement Manufacturing Company is engaged in the preparation of plans calling for the expenditure of approximately \$25,000 in increasing the barge loading facilities at the temporary terminal used by the company's barge fleet on the Illinois river at Peru during the past year, according to the *Daily Post-Tribune* (La Salle, Ill.), of January 2.

Walter A. Wecker, secretary-treasurer of the company, pointed out that the Marquette concern is looking forward to using waterway transportation on a much larger scale than heretofore in the movement of cement from the Oglesby mill to lower Mississippi distribution points, which include Memphis, St. Louis and Vicksburg.

### Prepare Plans

Just what improvements are to be made at the Peru terminal have not yet been definitely determined upon, but it was stated that a report from the engineers will be ready on or about February 1 and the work actually begun a short time after that date.

The Marquette official made it known that within the next year plans may be started by the company for the erection of a permanent barge terminal on the Illinois river, south of La Salle on the property purchased several months ago as a terminal site. This tract of land extends along the south bank of the river between the new Shippingsport bridge and the Illinois Central railroad bridge and is ideally situated for a dock.

### Longer Route Planned

At the same time it was ascertained through Robert B. Dickinson, vice-president of the Marquette company, that

the company tentatively contemplates an approximate 350-mile increase in its Illinois-Mississippi river cement shipping route. The new extension would be from Memphis to Vicksburg, which would make a total of about 1,000 miles for the full river run used by the company for its new type of tow-boats and cement barges. Heretofore, the river route was from Peru to as far south as Memphis.

### Serve More Cities

This new, longer route would permit the company to more easily serve all the river cities in the lower Mississippi region, as well as to effect a substantial saving by the use of its own equipment, which is considered the most modern for shallow water operations.

The Marquette company was the pioneer organization in the use of these new types of river tow-boats and barges. After a comparatively short test period the company established a regular shipping route from Peru to St. Louis, Cape Girardeau and Memphis. It is anticipated that if the extended route is finally determined upon, tow-boats and barges will begin operating on a regular schedule, starting as early in spring as river conditions permit.

### Marquette Monthly Shipments Continue to Exceed Those of 1930

Shipments of the Marquette Cement Manufacturing Co., Chicago, for November were approximately 20 per cent above those of November of 1930.

The eleven months ended November 30 showed a volume equal to that of the same period of 1930.

# MEN and MILLS

[ News of and for  
Cement Mill Men ]

A clearing-house page for all kinds of local cement mill news—to promote the comradeship and mutual-ity of interest that exists among those who make portland cement.

Readers in all mills, even though not regular contribu-tors, are invited to send in news notes about personal and plant activities that may be of interest or value to the men in other mills.

## George S. Bartlett Fund Award Is Made

Announcement that its work had been completed was made by the executive committee of the George S. Bartlett Fund on December 26. A bronze plaque, instead of a medal, was chosen as more acceptable, and the first presentation of the award was made to Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, at the recent American Road Builders' Association convention at Detroit.

"The artists chosen were Mr. and Mrs. Fred M. Torrey, of Chicago, who rank with the leading sculptors of America," the announcement states. "The bronze itself measures 7 by 10 inches, bears a portrait head of Bartlett, the title: 'George S. Bartlett Award,' and the inscription, 'For outstanding contribution to highway progress'."

More than \$2,000 were contributed by 194 friends, of which \$1,500 remain, to be deposited with one of the sponsors for the permanent endowment of an annual award.

The executive committee includes C. M. Babcock, S. F. Beatty, Pyke Johnson, E. J. Mehren, Blaine S. Smith, and W. R. Smith.

## Cement Making Process Described by Palmer

L. E. Palmer, general manager of the Wabash Portland Cement Co., at Osborn, Ohio, addressed the Wilmington (Ohio) Rotary Club at its regular weekly luncheon on Dec. 28.

The cement manufacturing process was the subject of his talk.

## Missouri Plan Gives Em- ployees Necessities at Cost

A plan for assisting its employees who are out of work and providing them with food, shelter and fuel at cost until improvement in business conditions is pronounced and employees are able to pay for them, was announced on December 15 by the Missouri Portland Cement Co., St. Louis, Mo.

A company commissary for dispensing food has been opened at the plant at Prospect Hill. Those unable to pay rent will be permitted to continue to live in company-owned houses, and coal will be furnished at cost, according to H. L. Block, president of the company.

Block said these plans will be available to 195 families, comprising 603 persons.

He said there will be no cost involved for the employees other than the actual cost of the articles sold them, and that they will be permitted to repay the company over a period of six months after they return to their jobs.

## Universal Atlas Mixed Chorus in Demand

Organized among members of the Chicago office, the Universal Atlas Cement Co. mixed chorus of sixty voices was a feature of business men's meetings in the Chicago loop during the holiday season. In addition, a radio appearance was made over station WMAQ on Wednesday, Dec. 23, which drew favorable comments from many listeners.

The chorus, organized in 1928 by B. F. Affleck, president of the company, annually sings carols on Christmas Eve in the corridors of the building at 208 South La Salle Street, where the company's offices are located.

Appearances were made this year before the Rotary Club, the Kiwanic Club and the Advertising Council of the Chicago Association of Commerce. The latter event was held to raise funds for the council's charity—the Off-the-Street Club.

Harry S. Walsh, who directs the Hamilton Club chorus and other choral groups, is conductor of the Universal Atlas singers.

## J. J. Horgan of Trinity Port- land Passes Away

John James Horgan, 49, purchasing agent for the Trinity Portland Cement Co., Dallas, Texas, and associated with the organization for twenty years, passed away January 8.

Offices of the firm were closed on the day of burial.

Mr. Horgan was widely known in business and social circles, and was a member of the Purchasing Agents' Association, Lakewood Athletic Club, and the Dallas Athletic Club.

His widow, four brothers and two sisters survive.

## M. L. Silcox New Penn- Dixie Safety Engineer

M. L. Silcox has been appointed safety engineer at the Penn-Dixie Cement Corp. plant No. 8 at Valley Junction, Iowa.

He succeeds E. N. Dodd.

## Association Appoints H. R. Albion Assistant Eastern Manager

Announcement has been made by the Portland Cement Association of the appointment of Henry R. Albion as assistant manager, eastern offices, with headquarters at Atlanta.

Mr. Albion, who has been well known for several years in connection with roads and other public improvement work in the southeastern states, entered the field promotion work of the association in Florida in March, 1926, and was appointed district engineer in charge of association activities in that state in 1927.

Mr. Albion received his schooling in South Dakota, where he attended the State School of Mines at Rapid City. Subsequently, he was engaged in important engineering work in that state and for several years was senior partner of the engineering firm of Albion and Ewing.

In his new capacity, Mr. Albion will serve as assistant to J. R. Fairman, manager of the eastern offices of the Portland Cement Association, concentrating his attention on association work in the southeastern states.

## "Safety Feed" Honors Lehigh Plant Workers

One hundred fifty male employees of the Lehigh Portland Cement Co. plant at Iola, Kans., were guests of the company at a "Safety Feed" at noon on January 9. The celebration was held in honor of the men who have enabled the plant to work through more than five years without a lost-time accident. No outsiders or women were present and the program was entirely informal.

Tables and benches had been erected in the repair shop building for the occasion. Food prepared by a local restaurant was served by men.

The Lehigh Four, F. P. Hoover, Earl Drake, Harold Baptist and P. B. Fegely, led the men in singing before and after the meal.

## Lewis Lloyd Lone Star Sales Manager

The Lone Star Cement Co., Alabama, announces the appointment of Lewis Lloyd as sales manager.

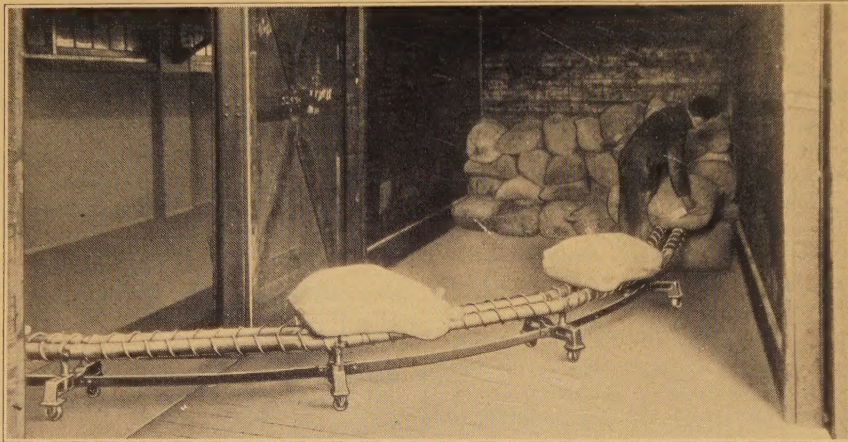
# Mill Equipment

## Kar Kit Developed for Loading and Unloading Freight Cars

The use of "Kar Kit" portable, flexible equipment is said to double the speed of loading and unloading freight cars while cutting the labor cost in two.

The "Kar Kit" is a development of the Clark TwinVeyor, which consists of

onto the first section of the "Kar Kit" on the loading dock. Thence they travel into the freight car to the spot where they are to be piled. They are presented to the piler at convenient height for storing. As one end of the car is loaded the entire



two parallel spiral tubes that are constantly turned toward each other by a power head. A bag placed on the TwinVeyor travels at a speed of 90 ft. per minute. The "Kar Kit," as well as the "TwinVeyor," is made by the Clark Trutractor Co., Battle Creek, Mich.

The "Kar Kit" comprises an assembly of these TwinVeyor sections mounted on casters for easy mobility. Bags are discharged from chutes, a long TwinVeyor line or any other conveyor system direct

"Kar Kit" moves back and when the center section is reached the equipment can be whipped around into the opposite end of the car. Slip-sleeve sections of the "TwinVeyor" tubes make it possible for the line to be turned right or left on entering the car door, still keeping the tubes parallel and on constant centers. One man can easily move the entire loading unit, even while it is in operation, according to the manufacturer.

Car unloading is simply a reverse of the loading operation. The "Kar Kit" with one man in the car, keeps a constant stream of bags flowing from the car into the warehouse where they may be picked up automatically by a "TwinVeyor" line or other conveying system.

## Gearmotors Are New Westinghouse Unit Drives

A simple, compact and efficient arrangement for powering various motor-driven equipment which operates at reduced motor speeds is said to be afforded by new unit drives now available from the Westinghouse Electric and Manufacturing Co., Nuttall Works, Pittsburgh, Pa.

These new drives which are known as Gearmotors, consist of speed reducers combined with motors forming self-contained units only a few inches longer over all than motors alone. Prominent advantages afforded by this combination of power and

speed reducing equipment include economy in space requirements, easy and simplified installation, reduced number of drive parts, high efficiency of operation, and assured low maintenance requirements, it is stated.

Each unit includes a Westinghouse type CS general purpose induction motor and a double reduction, non-planetary type helical gear speed reducer built onto the one-piece motor frame forming an assembly which is supported entirely by the motor feet.

An improvement in motor construction incorporated in these unit drives is the pre-wound primary core which is separable from the stator frame. This feature makes possible economies in motor operation and maintenance, and in repair parts stocks. It also permits quick and inexpensive change of motor speed, voltage, and phase. Practically indestructible rotor, dual treated windings, directed ventilation, and ball bearings are other motor construction features of these drives.

The speed-reducing mechanism is fully enclosed in a two-piece housing which is rigidly bolted to the motor frame.

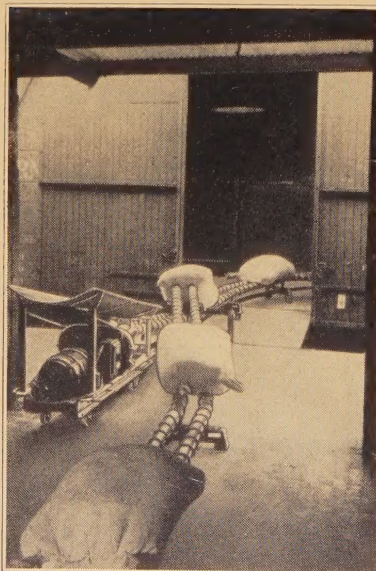
The desired reduction of motor speed is obtained by helical gears and pinions, the teeth of which are cut to a high degree of accuracy by the hobbing process. All gear and pinion shafts are supported on roller bearings. By a simple splash system of lubrication, all moving parts of the speed reducing mechanism and one motor bearing receive a supply of oil continuously during operation. The lower section of the housing forms a reservoir for the lubricant. The other motor bearing is packed with grease. Adjoining faces of the two sections of the housings are machined and bolted together to form an oil-tight, dirt-proof enclosure. No gasket is used. Convenient plugs for checking the oil level, refilling or draining the oil supply are provided.

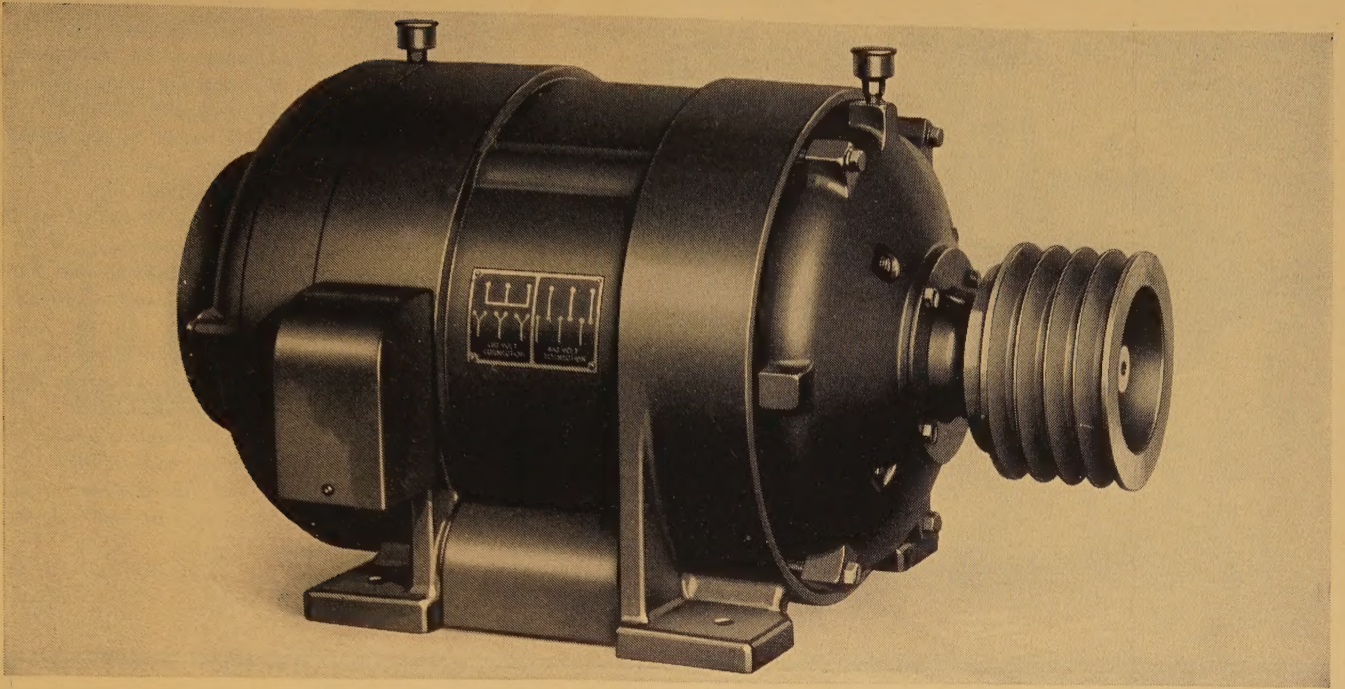
Initial lubricant requirements for these units range from 1½ qt. for the smallest size to 4½ qt. for the largest, with only infrequent refilling necessary thereafter.

Ventilating air for the motor is taken in through an opening in the lower section of speed reducer housing and properly directed by a curved shield integral with the interior of the housing.

## A-E-Co Makes New Electro-Hydraulic Transmission

Flexibility is one of the features of the new electro-hydraulic transmission unit of the American Engineering Co., Philadelphia, Pa. Its speed is said to be variable from zero to maximum without changing or shifting of gears or belts, without pulleys





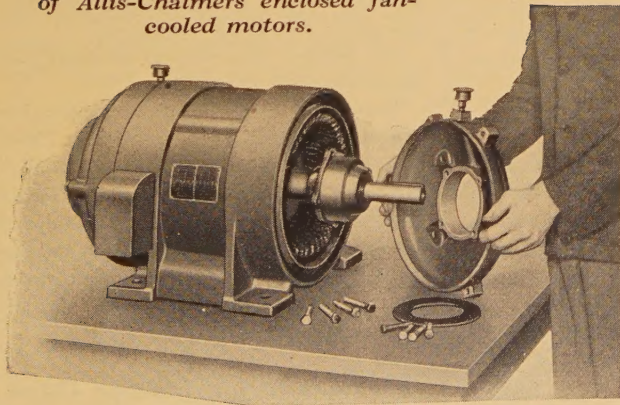
## Your Maintenance Man Knows the Value of these Enclosed Motors

HE knows that where dust, dirt, moisture, dripping water, or destructive gases are present . . . those drives in out of the way places where motor windings become clogged or moisture soaked . . . there, Allis-Chalmers enclosed fan-cooled motors reduce trouble and operating expense.

He knows that sturdy construction, liberal design, and unexcelled insulation are features of Allis-Chalmers motors and that the enclosed-fan-cooled type, while thoroughly protected, is readily accessible.

Allis-Chalmers enclosed fan-cooled motors approved by the Underwriters for dusty locations are described in Leaflet 2124. Explosion-proof motors, also approved, are described in Leaflet 2125-A.

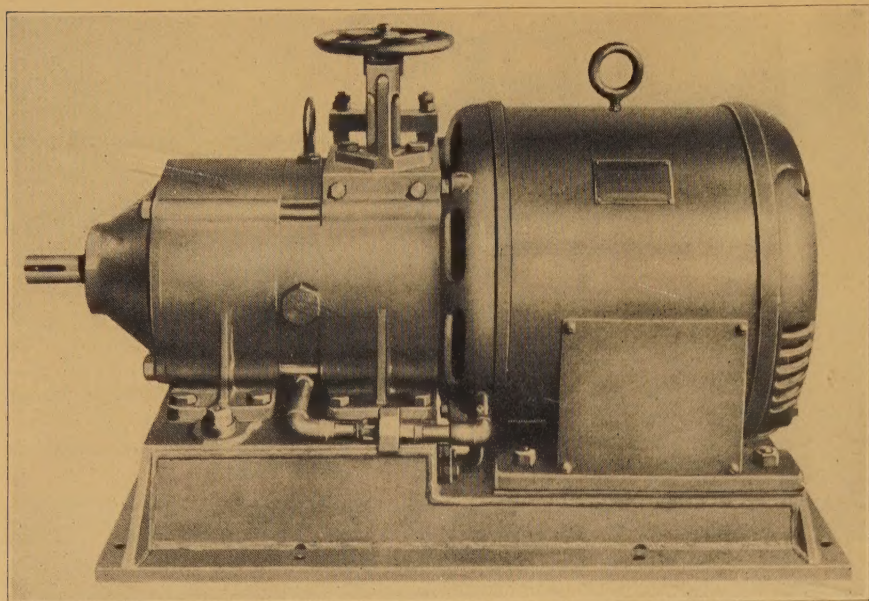
*Complete and ready accessibility to all parts is one of the features of Allis-Chalmers enclosed fan-cooled motors.*



**Allis-Chalmers Mfg. Co., Milwaukee**

# ALLIS-CHALMERS MOTORS

*This advertisement is to help you get ready for better business*



or chains, or complicated electrical controls.

A second advantage is its reversibility, either direction of rotation being available without gears or mechanical means.

An across-the-line starter with push button station starts the transmission and power is developed hydraulically.

Other features pointed out by the manufacturer are as follows:

1. The oil which is used as the fluid medium reaches and lubricates all working parts.
2. The compressibility of the oil medium cushions ordinary shocks on the driving shaft.
3. No packing of any kind is used.
4. The transmission case is dry. Oil flowing through the transmission is not "whipped" or "churned" by parts moving across its path.

The 5-h.p. size is 31 in. long, 16 in. high and 14 in. wide.

## About Manufacturers of Equipment

### Industrial Literature

#### Norblo Filters

The changes and improvements in Norblo dust filters are described in Bulletin No. 500-1, just issued by the *Northern Blower Co., Cleveland, Ohio.*

These are continuous operating air filters, said to be automatic in action and self-cleaning. Their salient features are described and illustrated.

### Notes from the Field

#### Babcock & Wilcox, Fuller Lehigh Consolidate

The *Babcock & Wilcox Co.*, 85 Liberty Street, New York, N. Y., announces a further consolidation of the resources and facilities of the Babcock & Wilcox and the *Fuller Lehigh* organizations, effective January 1st. The sales offices of the two companies have been combined and all business heretofore carried on separately or jointly by these companies will be done in the name of the Babcock & Wilcox Co. through its district sales offices.

As part of a program whereby the Babcock & Wilcox Co. is able to furnish any equipment which might be required to burn fuel and generate steam, the company purchased, in 1926, the *Fuller Lehigh* Company, manufacturers of pulverized fuel equipment and to this line was added Bailey furnace walls, formerly manufactured and sold by the *Bailey Meter Co.*

All manufacturing of pulverized fuel

equipment and water-cooled furnace walls was concentrated at the *Fuller Lehigh Co.*'s plant, Fullerton, Pa.

The business developed rapidly, and the use of pulverized fuel also increased at a very rapid rate, an announcement states. Concurrently, the trend toward higher steam pressures and larger boiler units gave the water-cooled furnace added importance and led to a further consolidation of the two companies' engineering and manufacturing of boilers and furnaces. So, in the early part of 1931, the manufacturing operations of the *Fuller Lehigh* Company were combined with those of the *Babcock & Wilcox Co.* at its *Barberton, Ohio*, works.

This latest consolidation will, the company states, result in a better and more efficient sales service to the customers of both organizations and others with whom the company does business.

#### Grothaus Succeeds Searle as Allis-Chalmers Representative

*L. W. Grothaus* has been appointed to succeed *C. E. Searle* as general representative of the *Allis-Chalmers Manufacturing Co.*

Mr. Grothaus became affiliated with the *Allis-Chalmers Manufacturing Co.* with the acquisition of the *Bullock Electric Manufacturing Co.*, Norwood, Ohio, in 1904. He was transferred to the home office at Milwaukee in 1908. In 1913, he became sales engineer in the Milwaukee district under the leadership of *C. E. Searle*, and continued in that capacity until 1917, when his services were loaned

to the government as a member of the staff of the War Industries Board.

His appointment as general representative became effective January 1, 1932.

*Clarence E. Searle*, general representative of the *Allis-Chalmers Manufacturing Co.*, has resigned to accept the vice-presidency of an eastern firm, his resignation becoming effective January 31st. Mr. Searle entered the service of the *Allis-Chalmers Company* in October, 1908. He had previously represented the *Fort Wayne Electric Works* (division of the *General Electric Company*) in the Milwaukee district. Since 1915 he had been in charge of the sales organization of *Allis-Chalmers* and generally directed the sales activities of the company. His work brought him in intimate contact with prominent business executives all over the country.

Mr. Searle's plans were to be announced about February 1.

General Falk, president, in announcing Mr. Searle's resignation, stated that "It is with great regret that I am obliged to announce Mr. Searle's resignation. He has proved a capable executive, a faithful and conscientious worker, and has endeared himself to the organization, all of whom join me in extending best wishes for his future success."

#### Harrison to C-E Chicago Office

*Combustion Engineering Corporation*, New York City, announces that *J. D. Harrison*, district manager of the Chicago office from 1922 to 1929, has been re-appointed to that position effective January 1, with offices in Bankers Building, Adams and Clark Streets, Chicago.